

WHAT IS CLAIMED IS:

1. ~~An image recording method for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel with one of N gradation values, said method comprising the steps of:~~

an input step for inputting image data including gradation-value information and position information relating to each pixel;

a first selection step for selecting one dot-pattern table based on gradation-value information indicated by each pixel of the image data input in said input step, from among N dot-pattern tables, each having a plurality of different dot patterns, corresponding to respective ones of the N gradation values;

a second selection step for selecting one dot pattern based on position information indicated by the pixel from the dot-pattern table selected in said first selection step; and

a recording step for recording an ink dot based on the dot pattern selected in said second selection step on a recording medium using a recording head.

2. An image recording method according to Claim 1, wherein each of the N dot-pattern tables is a two-dimensional table expanding in a first direction substantially corresponding to a direction of arrangement of nozzles of the recording head and in a second direction substantially corresponding to a moving direction of the recording head, and wherein the dot pattern is a two-dimensional pattern expanding in the first direction and in the second

direction

3. An image recording method according to Claim 2, wherein, when sizes of the dot-pattern table in the first direction and the second direction are represented by L and K, and sizes of the dot pattern in the first direction and the second direction are represented by l and k, respectively, the size of the dot-pattern table and the size of the dot pattern have relationships of  $L = \alpha \times l$  ( $\alpha$  is a natural number), and  $K = \beta \times k$  ( $\beta$  is a natural number), and wherein  $\alpha$  dot patterns and  $\beta$  dot patterns having the same gradation value are stored in the first direction and the second direction, respectively, in the dot-pattern table.

4. An image recording method according to Claim 3, wherein the dot-pattern table is repeatedly used at every L pixels in the first direction, and at every K pixels in the second direction.

5. An image recording method according to Claim 3, wherein a number of cells L of the dot-pattern table in the first direction and a number of nozzles A of the recording head have a relationship of  $L = \gamma \times A$  ( $\gamma$  is a natural number).

6. An image recording method according to Claim 3, wherein, when the position information indicated by the pixel is represented by two-dimensional coordinates (x, y), and the x coordinate and the y coordinate correspond to the second direction and the first direction, respectively, the dot pattern selected in said second selection step is a dot pattern at a position

specified based on the x coordinate value, the y coordinate value, the value  $\alpha$ , and the value  $\beta$  within the dot-pattern table.

7. An image recording method according to Claim 3, wherein the dot-pattern table is determined in consideration of characteristics of each of a plurality of nozzles of the recording head.

8. An image recording method according to Claim 7, wherein a number of dot-pattern tables determined in consideration of the characteristics of each of the nozzles, from among the N dot-pattern tables provided for corresponding ones of the N gradation values, is H ( $N > H$ , H is a natural number).

9. An image recording method according to Claim 7, wherein the dot-pattern table determined in consideration of the characteristics of each of the nozzles is a dot-pattern table corresponding to a gradation value such that a ratio of dots D (%) provided within a pixel is within a range of  $25 \leq D \leq 50$ .

10. An image recording method according to Claim 3, wherein cells in the second direction from among cells positioned at end portions of the dot-pattern table do not include dot information.

11. An image recording method according to Claim 3, wherein the gradation value of a dot pattern positioned at an end portion of the dot-pattern table in the second direction is smaller than the gradation value

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indicated by the dot-pattern table where the dot pattern is stored.

12. An image recording method according to Claim 3, wherein the dot-pattern table has a blue-noise characteristic.

13. An image recording method according to Claim 12, wherein the blue-noise characteristic is a characteristic in which a power spectrum in a low-frequency region of an image recorded based on the image data is smaller than a power spectrum of a high-frequency region.

14. An image recording method according to Claim 1, wherein in said recording step, the recording head performs recording by scanning the same region on the recording medium a plurality of times.

15. An image recording method according to Claim 1, wherein the recording head is an ink-jet recording head for performing recording by discharging ink.

16. An image recording method according to Claim 15, wherein the ink-jet recording head discharges ink by utilizing thermal energy, and includes a thermal-energy generation member for generating the thermal energy provided to the ink.

17. An image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel with one of N gradation values, said apparatus

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~~comprising:~~

an input unit for inputting image data including gradation-value information and position information relating to each pixel;

a dot-pattern-table storage unit for storing N dot-pattern tables, each having a plurality of different dot patterns, corresponding to respective ones of the N gradation values;

first selection means for selecting one dot-pattern table from said dot-pattern-table storage unit, based on gradation-value information indicated by each pixel of the image data input by said input unit;

second selection means for selecting one dot pattern from the dot-pattern table selected by said first selection means, based on position information indicated by the pixel; and

recording control means for controlling a recording head so as to record an ink dot based on the dot pattern selected by said second selection means on a recording medium.

18. An image recording apparatus according to Claim 17, wherein each of the N dot-pattern tables is a two-dimensional table expanding in a first direction substantially corresponding to a direction of arrangement of nozzles of the recording head and in a second direction substantially corresponding to a moving direction of the recording head, and wherein the dot pattern is a two-dimensional pattern expanding in the first direction and in the second direction.

19. An image recording apparatus according to Claim 18, wherein, when sizes of the dot-pattern table in the first direction and the second

direction are represented by L and K, and sizes of the dot-pattern table in the first direction and the second direction are represented by l and k, respectively, the size of the dot-pattern table and the size of the dot pattern have relationships of  $L = \alpha \times l$  ( $\alpha$  is a natural number), and  $K = \beta \times k$  ( $\beta$  is a natural number), and wherein  $\alpha$  dot patterns and  $\beta$  dot patterns having the same gradation value are stored in the first direction and the second direction, respectively, in the dot-pattern table.

20. An image recording apparatus according to Claim 19, wherein the dot-pattern table is repeatedly used at every L pixels in the first direction, and at every K pixels in the second direction.

21. An image recording apparatus according to Claim 19, wherein a number of cells L of the dot-pattern table in the first direction and a number of nozzles A of the recording head have a relationship of  $L = \gamma \times A$  ( $\gamma$  is a natural number).

22. An image recording apparatus according to Claim 19, wherein, when the position information indicated by the pixel is represented by two-dimensional coordinates (x, y), and the x coordinate and the y coordinate correspond to the second direction and the first direction, respectively, the dot pattern selected by said second selection means is a dot pattern at a position specified based on the x coordinate value, the y coordinate value, the value  $\alpha$ , and the value  $\beta$  within the dot-pattern table.

23. An image recording apparatus according to Claim 19, wherein the

dot-pattern table is determined in consideration of characteristics of each of a plurality of nozzles of the recording head.

24. An image recording apparatus according to Claim 23, wherein a number of dot-pattern tables determined in consideration of the characteristics of each of the nozzles, from among the  $N$  dot-pattern tables provided for corresponding ones of the  $N$  gradation values, is  $H$  ( $N > H$ ,  $H$  is a natural number).

25. An image recording apparatus according to Claim 23, wherein the dot-pattern table determined in consideration of the characteristics of each of the nozzles is a dot-pattern table corresponding to a gradation value such that a ratio of dots  $D$  (%) provided within a pixel is within a range of  $25 \leq D \leq 50$ .

26. An image recording apparatus according to Claim 19, wherein cells in the second direction from among cells positioned at end portions of the dot-pattern table do not include dot information.

27. An image recording apparatus according to Claim 19, wherein the gradation value of a dot pattern positioned at an end portion of the dot-pattern table in the second direction is smaller than the gradation value indicated by the dot-pattern table where the dot pattern is stored.

28. An image recording apparatus according to Claim 19, wherein the dot-pattern table has a blue-noise characteristic.

29. An image recording apparatus according to Claim 28, wherein the blue-noise characteristic is a characteristic in which a power spectrum in a low-frequency region of an image recorded based on the image data is smaller than a power spectrum of a high-frequency region.

30. An image recording apparatus according to Claim 17, wherein said recording control means controls the recording head so as to perform recording by scanning the same region on the recording medium a plurality of times.

31. An image recording apparatus according to Claim 17, wherein the recording head is an ink-jet recording head for performing recording by discharging ink.

32. An image recording apparatus according to Claim 31, wherein the ink-jet recording head discharges ink by utilizing thermal energy, and comprises a thermal-energy generation member for generating the thermal energy provided to the ink.

33. A method for controlling an image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel with one of N gradation values, said method comprising the steps of:

a first control step for performing control so as to input image data including gradation-value information and position information relating to



~~each pixel;~~

a second control step for performing control so as to select one dot-pattern table based on gradation-value information indicated by each pixel of the image data input in said first control step, from among N dot-pattern tables, each having a plurality of different dot patterns, corresponding to respective ones of the N gradation values;

a third control step for performing control so as to select one dot pattern based on position information indicated by the pixel, from the dot-pattern table selected in said second control step; and

a fourth control step for performing control so as to record an ink dot based on the dot pattern selected in said third control step on a recording medium using a recording head.

34. A storage medium, capable of being read by a computer, storing program codes for executing recording control processing for an image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel with one of N gradation values, said program codes comprising:

(a) a code of an input step for inputting image data including gradation-value information and position information relating to each pixel;

(b) a code of a first selection step for selecting one dot-pattern table based on gradation-value information indicated by each pixel of the image data input in said input step, from among N dot-pattern tables, each having a plurality of different dot patterns, corresponding to respective ones of the N gradation values;

(c) a code of a second selection step for selecting one dot pattern based

on position information indicated by the pixel, from the dot-pattern table selected in said first selection step; and

(d) a code of a recording step for recording an ink dot based on the dot pattern selected in said second selection step on a recording medium using a recording head.

35. An image processing method for outputting a dot pattern corresponding to each gradation value, based on image data representing each pixel with one of N gradation values, said method comprising the steps of:

an input step for inputting image data including gradation-value information and position information relating to each pixel;

a first selection step for selecting one dot-pattern table based on gradation-value information indicated by each pixel of the image data input in said input step, from among N dot-pattern tables, each having a plurality of different dot patterns, corresponding to respective ones of the N gradation values;

a second selection step for selecting one dot pattern based on position information indicated by the pixel, from the dot-pattern table selected in said first selection step; and

an output step for outputting the dot pattern selected in said second selection step.

36. An image processing method according to Claim 35, wherein each of the N dot-pattern tables is a two-dimensional table expanding in a first direction substantially corresponding to a direction of arrangement of nozzles

of the recording head and in a second direction substantially corresponding to a moving direction of the recording head, and wherein the dot pattern is a two-dimensional pattern expanding in the first direction and in the second direction.

37. An image processing method according to Claim 36, wherein, when sizes of the dot-pattern table in the first direction and the second direction are represented by L and K, and sizes of the dot-pattern table in the first direction and the second direction are represented by l and k, respectively, the size of the dot-pattern table and the size of the dot pattern have relationships of  $L = \alpha \times l$  ( $\alpha$  is a natural number), and  $K = \beta \times k$  ( $\beta$  is a natural number), and wherein  $\alpha$  dot patterns and  $\beta$  dot patterns having the same gradation value are stored in the first direction and the second direction, respectively, in the dot-pattern table.

38. An image processing method according to Claim 37, wherein the dot-pattern table is repeatedly used at every L pixels in the first direction, and at every K pixels in the second direction.

39. An image processing method according to Claim 37, wherein a number of cells L of the dot-pattern table in the first direction and a number of nozzles A of the recording head have a relationship of  $L = \gamma \times A$  ( $\gamma$  is a natural number).

40. An image processing method according to Claim 37, wherein, when the position information indicated by the pixel is represented by

~~two-dimensional coordinates (x, y), and the x coordinate and the y coordinate~~  
correspond to the second direction and the first direction, respectively, the dot pattern selected in said second selection step is a dot pattern at a position specified based on the x coordinate value, the y coordinate value, the value  $\alpha$ , and the value  $\beta$  within the dot-pattern table.

41. An image processing method according to Claim 37, wherein the dot-pattern table is determined in consideration of characteristics of each of a plurality of nozzles of the recording head.

42. An image processing method according to Claim 41, wherein a number of dot-pattern tables determined in consideration of the characteristics of each of the nozzles, from among the N dot-pattern tables provided for corresponding ones of the N gradation values, is H ( $N > H$ , H is a natural number).

43. An image processing method according to Claim 41, wherein the dot-pattern table determined in consideration of the characteristics of each of the nozzles is a dot-pattern table corresponding to a gradation value such that a ratio of dots D (%) provided within a pixel is within a range of  $25 < D < 50$ .

44. An image processing method according to Claim 37, wherein cells in the ~~second direction from~~ among cells positioned at end portions of the dot-pattern table do not include dot information.

46. An image processing method according to Claim 37, wherein the dot-pattern table has a blue-noise characteristic.

47. An image processing method according to Claim 46, wherein the blue-noise characteristic is a characteristic in which a power spectrum in a low-frequency region of an image recorded based on the image data is smaller than a power spectrum of a high-frequency region.

48. An image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel by one of N gradation values, said apparatus comprising:

an input unit for inputting image data including gradation-value information and position information relating to each pixel;

selection means for selecting one dot pattern based on gradation-value information and position information indicated by each pixel of the image data input by said input unit, from a dot-pattern-table storage unit for storing X ( $N > X$ , X is a natural number) dot patterns, each having a plurality of different dot patterns, corresponding to respective ones of X gradation values; and

dot-pattern generation means for generating dot patterns

corresponding to  $(N - X)$  predetermined gradation values,

wherein, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit, the dot pattern selected by said selection means is recorded by a recording head, and

wherein, when a dot-pattern table corresponding to the gradation-value information is not stored in the dot-pattern-table storage unit, dot patterns corresponding to the predetermined gradation values generated by said dot-pattern generation means are recorded by the recording head.

49. An image recording apparatus according to Claim 48, wherein the dot pattern generated by said dot-pattern generation means is a dot pattern having a fixed dot arrangement.

50. An image recording apparatus according to Claim 49, wherein the dot pattern generated by said dot-pattern generation means is a dot pattern in which no dot is recorded on all dot positions.

51. An image recording apparatus according to Claim 49, wherein the dot pattern generated by said dot-pattern generation means is a dot pattern in which dots are recorded on all dot positions.

52. An image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel by one of  $N$  gradation values, said apparatus

an input unit for inputting image data including gradation-value information and position information relating to each pixel;

first selection means for selecting one dot pattern from said dot-pattern-table storage unit, based on gradation-value information indicated by each pixel of the image data input by said input unit;

dot-pattern / generation means for generating dot patterns  
corresponding to (N - X) predetermined gradation values,

wherein a number of cells L within the dot-pattern table in the first direction and a number of nozzles A of the recording head have a relationship of  $L = \alpha \times A$  ( $\alpha$  is a natural number),

wherein, when a dot-pattern table corresponding to the gradation-value information is not stored in said dot-pattern-table storage

unit, the dot patterns corresponding to the predetermined gradation values generated by said dot-pattern generation means are recorded by the recording head.

53. An image recording apparatus according to Claim 52, wherein the dot pattern generated by said dot-pattern generation means is a dot pattern having a fixed dot arrangement.

54. An image recording apparatus according to Claim 53, wherein the dot pattern generated by said dot-pattern generation means is a dot pattern in which no dot is recorded on all dot positions.

55. An image recording apparatus according to Claim 53, wherein the dot pattern generated by said dot-pattern generation means is a dot pattern in which dots are recorded on all dot positions.

56. An image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel with one of N (N is an integer equal to or larger than 3) gradation values, said apparatus comprising:

an input unit for inputting image data including gradation-value information and position information relating to each pixel;

a dot-pattern-table storage unit for storing X ( $N > X$ , X is a natural number) dot-pattern tables, each having a plurality of different dot patterns, corresponding to X gradation values provided at intervals of every other gradation level;



first selection means for selecting one dot-pattern table from said dot-pattern-table storage unit, based on gradation-value information indicated by each pixel of the image data input by said input unit;

second selection means for selecting one dot pattern based on position information indicated by the pixel, from the dot-pattern table selected by said first selection means; and

dot-pattern interpolation means for generating dot patterns corresponding to  $(N - X)$  predetermined gradation values, based on a dot pattern within the dot-pattern table corresponding to a gradation value larger than a corresponding one of the predetermined gradation values by one, and a dot pattern within the dot-pattern table corresponding to a gradation value smaller than the corresponding one of the predetermined gradation values by one,

wherein the dot-pattern table is a two-dimensional table expanding in a first direction corresponding to a direction of arrangement of nozzles of the recording head and in a second direction different from the first direction,

wherein a number of cells  $L$  within the dot-pattern table in the first direction and a number of nozzles  $A$  of the recording head have a relationship of  $L = \alpha \times A$  ( $\alpha$  is a natural number),

wherein, when a dot-pattern table corresponding to the gradation-value information is stored in said dot-pattern-table storage unit, the dot pattern selected by said second selection means is recorded by a recording head, and

wherein, when a dot-pattern table corresponding to the gradation-value information is not stored in said dot-pattern-table storage unit, the dot patterns corresponding to the predetermined gradation values

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generated by said dot-pattern interpolation means are recorded by the recording head.

57. An image recording apparatus according to Claim 48, further comprising:

quantization means for quantizing image data representing each pixel with M ( $M > N$ ) values into image data representing each pixel with one of N gradation values.

58. An image recording apparatus according to Claim 48, wherein the recording head is an ink-jet recording head for performing recording by discharging ink.

59. An image recording apparatus according to Claim 48, wherein the ink-jet recording head comprises a thermal-energy generation member for providing the ink with thermal energy, and discharges the ink by causing a change in a state of the ink due to heat.

60. An image recording method for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel by one of N gradation values, said method comprising the steps of:

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an input step for inputting image data including gradation-value information and position information relating to each pixel;

a selection step for selecting one dot pattern based on gradation-value information and position information indicated by each pixel of the image

~~data input in said input step, from a dot-pattern-table storage unit for storing~~  
X ( $N > X$ , X is a natural number) dot patterns, each having a plurality of  
different dot patterns, corresponding to respective ones of X gradation values,  
and

a dot-pattern generation step for generating dot patterns  
corresponding to  $(N - X)$  predetermined gradation values,

wherein, when a dot-pattern table corresponding to the  
gradation-value information is stored in the dot-pattern-table storage unit,  
the dot pattern selected in said selection step is recorded by a recording head,  
and

wherein, when a dot-pattern table corresponding to the  
gradation-value information is not stored in the dot-pattern-table storage  
unit, the dot patterns corresponding to the predetermined gradation values  
generated in said dot-pattern generation step are recorded by the recording  
head.

61. An image recording method according to Claim 60, wherein the  
dot pattern generated in said dot-pattern generation step is a dot pattern  
having a fixed dot arrangement.

62. An image recording method according to Claim 61, wherein the  
dot pattern generated in said dot-pattern generation step is a dot pattern in  
which no dot is recorded on all dot positions.

63. An image recording method according to Claim 61, wherein the  
dot pattern generated in said dot-pattern generation step is a dot pattern in

which dots are recorded on all dot positions.

64. An image recording method for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel by one of N gradation values, said method comprising the steps of:

an input step for inputting image data including gradation-value information and position information relating to each pixel;

a first selection step for selecting one dot pattern based on gradation-value information indicated by each pixel of the image data input in said input step, from a dot-pattern-table storage unit for storing X ( $N > X$ , X is a natural number) dot patterns, each having a plurality of different dot patterns, corresponding to respective ones of X gradation value;

a second selection step for selecting one dot pattern from the dot-pattern table selected in said first selection step, based on position information indicated by the pixel; and

a dot-pattern generation step for generating dot patterns corresponding to  $(N - X)$  predetermined gradation values,

wherein the dot-pattern table is a two-dimensional table expanding in a first direction corresponding to a direction of arrangement of nozzles of the recording head and in a second direction different from the first direction,

wherein a number of cells L within the dot-pattern table in the first direction and a number of nozzles A of the recording head have a relationship of  $L = \alpha \times A$  ( $\alpha$  is a natural number),

wherein, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit,

the dot pattern selected in said second selection step is recorded by a recording head, and

wherein, when a dot-pattern table corresponding to the gradation-value information is not stored in the dot-pattern-table storage unit, the dot patterns corresponding to the predetermined gradation values generated in said dot-pattern generation step are recorded by the recording head.

65. An image recording method according to Claim 64, wherein the dot pattern generated in said dot-pattern generation step is a dot pattern having a fixed dot arrangement.

66. An image recording method according to Claim 65, wherein the dot pattern generated in said dot-pattern generation step is a dot pattern in which no dot is recorded on all dot positions.

67. An image recording method according to Claim 65, wherein the dot pattern generated in said dot-pattern generation step is a dot pattern in which dots are recorded on all dot positions.

68. An image recording method for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel with one of N (N is an integer equal to or larger than 3) gradation values, said method comprising the steps of:

an input step for inputting image data including gradation-value information and position information relating to each pixel;

a first selection step for selecting one dot-pattern table based on gradation-value information indicated by each pixel of the image data input in said input step, from a dot-pattern-table storage unit for storing  $X$  ( $N > X$ ,  $X$  is a natural number) dot-pattern tables, each having a plurality of different dot patterns, corresponding to  $X$  gradation values provided at intervals of every other gradation level

a second selection step for selecting one dot pattern based on position information indicated by the pixel, from the dot-pattern table selected in said first selection step; and

a dot-pattern interpolation step for generating dot patterns corresponding to  $(N - X)$  predetermined gradation values, based on a dot pattern within a dot-pattern table corresponding to a gradation value larger than a corresponding one of the predetermined gradation values by one, and a dot pattern within a dot-pattern table corresponding to a gradation value smaller than the corresponding one of the predetermined gradation values by one,

wherein the dot-pattern table is a two-dimensional table expanding in a first direction corresponding to a direction of arrangement of nozzles of a recording head and in a second direction different from the first direction,

wherein a number of cells  $L$  within the dot-pattern table in the first direction and a number of nozzles  $A$  of the recording head have a relationship of  $L = \alpha \times A$  ( $\alpha$  is a natural number),

wherein, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit, the dot pattern selected in said second selection step is recorded by a recording head, and

wherein, when a dot pattern table corresponding to the gradation value information is not stored in the dot-pattern-table storage unit, the dot patterns corresponding to the predetermined gradation values generated in said dot-pattern interpolation step are recorded by the recording head.

A 69. An image recording method according to Claim <sup>68</sup>69, further comprising:

a quantization step for quantizing image data representing each pixel with M ( $M > N$ ) values into image data representing each pixel with one of N gradation values.

70. An image recording method according to Claim 60, wherein the recording head is an ink-jet recording head for performing recording by discharging ink.

71. An image recording method according to Claim 60, wherein the ink-jet recording head comprises a thermal-energy generation member for providing the ink with thermal energy, and discharges the ink by causing a change in a state of the ink due to heat.

72. A method for controlling an image apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data for representing each pixel by one of N gradation values, said method comprising the steps of:

a first control step for performing control so as to input image data

including gradation-value information and position information relating to each pixel;

a second control step for performing control so as to select one dot pattern based on gradation-value information and position information indicated by each pixel of the image data input in said first control step, from a dot-pattern-table storage unit for storing  $X$  ( $N > X$ ,  $X$  is a natural number) dot patterns, each having a plurality of different dot patterns, corresponding to respective ones of  $X$  gradation values; and

a third control step for performing control so as to generate dot patterns corresponding to  $(N - X)$  predetermined gradation values,

wherein, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit, the dot pattern selected in said second control step is recorded by a recording head, and

wherein, when a dot-pattern table corresponding to the gradation-value information is not stored in the dot-pattern-table storage unit, the dot patterns corresponding to the predetermined gradation values generated in said third control step are recorded by the recording head.

73. A method for controlling an image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data for representing each pixel by one of  $N$  gradation values, said method comprising the steps of:

a first control step for performing control so as to input image data including gradation-value information and position information relating to each pixel,



a second control step for performing control so as to select one dot pattern based on gradation-value information indicated by each pixel of the image data input in said first control step, from a dot-pattern-table storage unit for storing  $N > X$ ,  $X$  is a natural number) dot patterns, each having a plurality of different dot patterns, corresponding to respective ones of  $X$  gradation values unit;

a third control step for performing control so as to select one dot pattern from the dot-pattern table selected in said second selection step, based on position information indicated by the pixel; and

a fourth control step for performing control so as to generate dot patterns corresponding to  $(N - X)$  predetermined gradation values,

wherein the dot-pattern table is a two-dimensional table expanding in a first direction corresponding to a direction of arrangement of nozzles of the recording head and in a second direction different from the first direction,

wherein a number of cells  $L$  within the dot-pattern table in the first direction and a number of nozzles  $A$  of the recording head have a relationship of  $L = \alpha \times A$  ( $\alpha$  is a natural number),

wherein, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit, control is performed so as to record the dot pattern selected in said third control step by a recording head, and

wherein, when a dot-pattern table corresponding to the gradation-value information is not stored in the dot-pattern-table storage unit, control is performed so as to record the dot patterns corresponding to the predetermined gradation values generated in said fourth control step by the recording head.

74. A method for controlling an image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data for representing each pixel with one of N (N is an integer equal to or larger than 3) gradation values, said method comprising the steps of:

a first control step for performing control so as to input image data including gradation-value information and position information of each pixel;

a second control step for performing control so as to select one dot-pattern table based on gradation-value information indicated by each pixel of the image data input in said first control step, from a dot-pattern-table storage unit for storing X ( $N > X$ , X is a natural number) dot-pattern tables, each having a plurality of different dot patterns, corresponding to X gradation values provided at intervals of every other gradation level;

a third control step for performing control so as to select one dot pattern based on position information indicated by the pixel, from the dot-pattern table selected in said second control step; and

a fourth control step for performing control so as to generate dot patterns corresponding to  $(N - X)$  predetermined gradation values, based on a dot pattern within a dot-pattern table corresponding to a gradation value larger than a corresponding one of the predetermined gradation values by one, and a dot pattern within a dot-pattern table corresponding to a gradation value smaller than the corresponding one of the predetermined gradation values by one,

wherein the dot-pattern table is a two-dimensional table expanding in

a first direction corresponding to a direction of arrangement of nozzles of a recording head and in a second direction different from the first direction,

wherein a number of cells  $L$  within the dot-pattern table in the first direction and a number of nozzles  $A$  of the recording head have a relationship of  $L = \alpha \times A$  ( $\alpha$  is a natural number),

wherein, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit, control is performed so as to record the dot pattern selected in said third control step by a recording head, and

wherein, when a dot-pattern table corresponding to the gradation-value information is not stored in the dot-pattern-table storage unit, control is performed so as to record the dot patterns corresponding to the predetermined gradation values generated in said fourth control step by the recording head.

75. A storage medium, capable of being read by a computer, storing program codes for executing recording control processing for an image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel by one of  $N$  ( $N$  is an integer equal to or larger than 2) gradation values, said program codes comprising:

(a) a code for an input step for inputting image data including gradation-value information and position information relating to each pixel,

(b) a code for a selection step for selecting one dot pattern based on gradation-value information and position information indicated by each pixel of the image data input in said input step, from a dot-pattern-table storage

unit for storing  $X$  ( $N > X$ ,  $X$  is a natural number) dot-pattern tables, each having a plurality of different dot patterns, corresponding to respective ones of  $X$  gradation values;

(c) a code for a dot-pattern generation step for generating dot patterns corresponding to  $(N - X)$  predetermined gradation values;

(d) a code for a first control step for performing control so as to record, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit, the dot pattern selected in said selection step by a recording head; and

(e) a code for a second control step for performing control so as to record, when a dot-pattern table corresponding to the gradation-value information is not stored in the dot-pattern-table storage unit, the dot patterns corresponding to the predetermined gradation values generated in said dot-pattern generation step by the recording head.

76. A storage medium, capable of being read by a computer, storing program codes for executing recording control processing for an image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel by one of  $N$  gradation values, said program codes comprising:

(a) a code for an input step for inputting image data including gradation-value information and position information relating to each pixel;

(b) a code for a first selection step for selecting one dot pattern based on gradation-value information indicated by each pixel of the image data input in said input step, from a dot-pattern-table storage unit for storing  $X$  ( $N > X$ ,  $X$  is a natural number) dot patterns, each having a plurality of different

dot patterns, corresponding to respective ones of X gradation values unit;

(c) a code for a second selection step for selecting one dot pattern from the dot-pattern table selected in said first selection step, based on position information indicated by the pixel;

(d) a code for a dot-pattern generation step for generating dot patterns corresponding to  $(N - X)$  predetermined gradation values;

(e) a code for a first control step for performing control so as to record, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit, the dot pattern selected in said second selection step by a recording head; and

(f) a code for a second control step for performing control so as to record, when a dot-pattern table corresponding to the gradation-value information is not stored in the dot-pattern-table storage unit, the dot patterns corresponding to the predetermined gradation values generated in said dot-pattern generation step by the recording head.

77. A storage medium, capable of being read by a computer, storing program codes for executing recording control processing for an image recording apparatus for performing recording using a dot pattern corresponding to each gradation value, based on image data representing each pixel with one of N (N is an integer equal to or larger than 3) gradation values, said program codes comprising:

(a) a code for an input step for inputting image data including gradation-value information and position information relating to each pixel;

(b) a code for a first selection step for selecting one dot-pattern table based on gradation-value information indicated by each pixel of the image

data input in said input step, from a dot-pattern-table storage unit for storing  $N$  ( $N > X$ ,  $X$  is a natural number) dot-pattern tables, each having a plurality of different dot patterns, corresponding to respective ones of  $X$  gradation values provided at intervals of every other gradation level;

(c) a code for a second selection step for selecting one dot pattern based on position information indicated by the pixel, from the dot-pattern table selected in said first selection step;

(d) a code for a dot-pattern interpolation step for generating dot patterns corresponding to  $(N - X)$  predetermined gradation values, based on a dot pattern within the dot-pattern table corresponding to a gradation value larger than a corresponding one of the predetermined gradation values by one, and a dot pattern within the dot-pattern table corresponding to a gradation value smaller than the corresponding one of the predetermined gradation values by one;

(e) a code for a first control step for performing control so as to record, when a dot-pattern table corresponding to the gradation-value information is stored in the dot-pattern-table storage unit, the dot pattern selected in said second selection step by a recording head; and

(f) a code for a second control step for performing control so as to record, when a dot-pattern table corresponding to the gradation-value information is not stored in the dot-pattern-table storage unit, the dot patterns corresponding to the predetermined gradation values generated in said dot-pattern interpolation step by the recording head.

78. ~~An image recording apparatus for outputting dot patterns corresponding to respective gradation values and recording the output dot~~

patterns using recording materials having a plurality of colors by a recording unit, based on image data representing each pixel with one of N gradation values, said apparatus comprising:

an input unit for inputting image data including position information, gradation-value information and color information relating to each pixel;

a dot-pattern-table storage unit for storing N dot-pattern tables, each having a plurality of different dot patterns, corresponding to respective ones of the N gradation values, for each color of the recording materials; and

an output unit for outputting one dot pattern from said dot-pattern-table storage unit, based on position information, gradation-value information and color information indicated by each pixel of the image data input by said input unit,

wherein a size of a dot-pattern table corresponding to at least one specific color from among the dot-pattern tables stored for each of the plurality of colors is smaller than sizes of dot-pattern tables corresponding to colors other than the specific color.

79. An image recording apparatus according to Claim 78, wherein the specific color is a color having relatively high lightness from among the plurality of colors.

80. An image recording apparatus according to Claim 78, wherein the colors of the recording materials are four colors, i.e., cyan, magenta, yellow and black, and wherein the specific color is yellow.

81. An image recording apparatus according to Claim 78, wherein the

colors of the recording materials are six colors, i.e., cyan, light cyan, magenta, light magenta, yellow and black, and wherein the specific colors are light cyan, light magenta, and yellow.

82. An image recording apparatus according to Claim 78, wherein the recording material is ink, and wherein the recording unit is an ink-jet recording head for performing recording by discharging the ink.

83. An image recording apparatus according to Claim 82, wherein the ink-jet recording head is a head for discharging the ink utilizing thermal energy, and comprises a thermal-energy transducer for generating the thermal energy to be provided to the ink.

84. An image recording method for outputting dot patterns corresponding to respective gradation values and recording the output dot patterns using recording materials having a plurality of colors by a recording unit, based on image data representing each pixel with one of N (N is an integer equal to or larger than 2) gradation values, said method comprising the steps of:

an input step for inputting image data including position information, gradation-value information and color information relating to each pixel;

an output step for outputting one dot pattern based on position information, gradation-value information and color information indicated by each pixel of the image data input in said input step, from a dot-pattern-table storage unit for storing N dot patterns, each having a plurality of different dot patterns, corresponding to respective ones of the N gradation values, for



~~each color of the recording materials, and~~

a recording step for recording the dot pattern output in said output step by the recording unit,

wherein a size of a dot-pattern table corresponding to at least one specific color from among the dot-pattern tables stored for each of the plurality of colors is smaller than sizes of dot-pattern tables corresponding to colors other than the specific color.

85. An image recording method according to Claim 84, wherein the specific color is a color having relatively high lightness from among the plurality of colors.

86. An image recording method according to Claim 84, wherein the colors of the recording materials are four colors, i.e., cyan, magenta, yellow and black, and wherein the specific color is yellow.

87. An image recording method according to Claim 84, wherein the colors of the recording materials are six colors, i.e., cyan, light cyan, magenta, light magenta, yellow and black, and wherein the specific colors are light cyan, light magenta, and yellow.

88. An image recording method according to Claim 84, wherein the recording material is ink, and wherein the recording unit is an ink-jet recording head for performing recording by discharging the ink.

89. An image recording method according to Claim 88, wherein the

ink-jet recording head is a head for discharging the ink utilizing thermal energy, and comprises a thermal-energy transducer for generating the thermal energy to be provided to the ink.

[illegible]